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Report to the Ranking Minority Member,
Committee on Governmental Affairs,
U.S. Senate

July 1993

ARMY ACQUISITION

More Testing Needed to Solve Heavy Equipment Transporter System Problems



93-18711



National Security and
International Affairs Division

B-253867

July 16, 1993

The Honorable William V. Roth, Jr.
Ranking Minority Member
Committee on Governmental Affairs
United States Senate

Dear Senator Roth:

In response to your request, we reviewed the Army's acquisition of a new Heavy Equipment Transporter System (HETS). The new HETS, consisting of a tractor and semitrailer, is designed to transport tanks and other heavy equipment. In 1991, the Army expanded the HETS transportation company's mission and increased the required number of HETS. Our objectives were to determine whether the (1) Army had adequately justified the HETS company's expanded mission and increased HETS quantity requirement, (2) new HETS has demonstrated a capability to meet its mission requirements, and (3) Army's HETS acquisition complied with the Department of Defense's (DOD) fly-before-buy policy.¹

Background

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In the early 1980s, the Army identified a requirement for a new HETS capable of transporting the Abrams tank. The Abrams tank weighs almost 70 tons, a weight that exceeds the old HETS' load capacity of 60 tons. According to the Army, when the old HETS' load exceeds 60 tons, it experiences (1) excessive tire wear; (2) reduced brake performance, which reduces its speed from 40 miles per hour to below 25 miles per hour; and (3) increased maintenance. We previously reported on the need for a new HETS to carry the Abrams tank.² The Army determined that acquiring a new HETS without a development phase was low risk and, after competition, awarded separate tractor and semitrailer multiyear production contracts. On April 28, 1989, the Army awarded a \$116.2-million contract to Southwest Mobile Systems Corporation, St. Louis, Missouri, for 1,066 HETS semitrailers (\$107,000 unit price) and supporting logistic services. On January 12, 1990, it awarded a \$209.3-million contract to Oshkosh Truck Corporation, Oshkosh, Wisconsin, for 1,044 tractors (\$186,186 unit price) and supporting logistic services. In 1992, the Army exercised option clauses in both contracts for

¹The DOD fly-before-buy policy generally refers to building and testing a system to ensure that it will meet performance requirements before making major funding commitments.

²1992 Army Budget: Potential Reductions in Helicopter, Heavy Equipment, and Tank Programs (GAO/NSIAD-91-302BR, Sept. 27, 1991) and Operation Desert Storm: Early Performance Assessment of Bradley and Abrams (GAO/NSIAD-92-94, Jan. 10, 1992).

DTIC QUALITY INSPECTED 3

111 additional units at an additional cost of \$33.2 million. As of April 1993, the semitrailer contract totaled \$127.7 million and the tractor contract totaled \$234.1 million, for a combined total of \$361.8 million.³

Since September 1991, the Army has been conducting a production quality test to validate that the tractors and semitrailers have been manufactured in accordance with the contract specifications. In addition, the Army conducted an operational test of the new HETS between September 1991 and April 1992. An operational test is designed to assess a system's capability to accomplish its mission and its suitability for fielding when operated and maintained in a realistic environment by typical operators, crews, and units.

In 1991, the Army expanded the HETS transportation company's mission. Previously, the crews drove their combat vehicles to battle staging areas. With the expanded mission, the HETS are expected to transport the combat vehicles to these areas. The expanded mission increased the number of HETS required by the Army.

Results in Brief

The Army's justification for expanding the HETS transportation company's mission and increasing HETS quantity requirement appears adequate. An Army analysis showed, among other things, that achieving the expanded mission would result in substantial cost savings.

However, the new HETS has not met its contractually required reliability and maintainability levels, and a current test will not conclusively demonstrate compliance with those requirements. Also, the HETS has not shown that it can adequately accomplish its mission or that it is suitable for fielding. Moreover, the new system has a safety problem caused by the semitrailer's tendency to veer into the other lane on turns and curves.

The new HETS contracts originally contained language that embodied the spirit of the DOD fly-before-buy policy. However, the Army conditionally accepted deliveries of HETS before contractual reliability and maintenance requirements had been demonstrated.

³Contract amounts do not add to combined total amount because of a number of minor contract modifications that added \$3.1 million to the cost of the contracts.

Expanded HETS Transportation Companies' Mission Justified

The Army cited improved operational effectiveness and substantial cost savings to support its 1991 decision to expand the HETS transportation companies' mission. To support the expanded mission, the Army increased its needs requirement by 720 HETS, all in HETS transportation companies. The Army believes using the HETS to carry combat vehicles to battle staging areas instead of driving the vehicles improves the units' operational effectiveness.

According to the Army, the effectiveness of this expanded mission was demonstrated in Operation Desert Shield/Storm where virtually every Army combat unit relocated with truck transportation. Driving combat vehicles consumes large quantities of fuel, and the vehicles may require considerable maintenance before they are ready to fight. The Army also indicated that long drives fatigue combat vehicle crews and reduce their effectiveness. Thus, the Army believes that with HETS transport, heavy armor maneuver units arrive at the staging areas with full fuel, higher readiness, and fresher crews.

An Army analysis performed in 1990 showed it was much cheaper to transport rather than drive combat vehicles. The Army computed a cost savings of \$165,000 per mile for moving an armor brigade with support units when it used HETS. These savings were based on an estimated cost of \$180,000 per mile when the crews drove their armored vehicles and an estimated cost of \$15,000 when HETS transported the vehicles.

In 1991, the Army increased its needs requirement from 1,072 to 1,792 new HETS.⁴ The Army's analysis showed it needed to increase the number of HETS in its 12-corps HETS transportation companies from 36 to 96 systems to support the expanded mission. The Army established the number of HETS in each transportation company based on the need to transport an armor brigade and its support units at one time. An additional 640 HETS are required for equipment evacuation and replacement, maintenance support, unloading and loading equipment at port facilities, training, and other miscellaneous purposes.

⁴Due to affordability problems, the Army plans to meet the requirement with both new and existing HETS.

HETS Has Not Met Its Reliability and Maintainability Requirements

The HETS tractor and semitrailer have not met their contractual reliability and maintainability requirements during Army production quality testing through March 1993. For example, the new HETS did not meet its reliability requirement of 3,000-mean miles between mission-ending hardware failures. In the contracts, the 3,000-mean miles is based on three HETS operating 20,000 miles each for the tractor and 12,000 miles each for the semitrailer. The HETS tractors demonstrated 1,781-mean miles between such failures, and the semitrailers demonstrated 2,435-mean miles between such failures. However, the mean mileage for the semitrailer is only based on an average of 8,000 miles. Because of problems with the semitrailers, the Army never tested the semitrailers for the contractually required 12,000 miles.

Although the Army attributed some of the tractor shortcomings to design faults, it believed that most tractor problems were associated with either the tractor contractor's assembly practices or quality problems with individual subcontractors. On the other hand, the Army attributed the semitrailer test results to design problems primarily involving the trailer's suspension system.

The Army did not declare either the tractor or semitrailer production quality tests failures, which would have made the contractors liable for the cost of conducting a new test. Instead, at its own expense, the Army extended the production quality test to evaluate HETS tractors and semitrailers manufactured with modifications. The Army began the extended testing in May 1993. However, the results from this test will not be conclusive because the Army plans to run three HETS only 8,000 miles each instead of the contractually required 20,000 miles each for tractors and 12,000 miles each for semitrailers.

The Army chose an 8,000-mile test because Army officials believed full testing would delay fielding a critically needed HETS by over a year. Also, they decided to limit the extended test to 8,000 miles because 85 percent of the failure types identified in previous tests occurred within the first 8,000 miles of testing. Moreover, they considered the risk of further failure of either the tractor or semitrailer in the extended test to be relatively low.

U.S. Army Test and Evaluation Command (TECOM)⁶ officials, however, expressed, in writing, three reservations over the test length. They said that the Army's test would not (1) demonstrate compliance with the contractual reliability and maintainability requirements; (2) conclusively

⁶TECOM is responsible for conducting and assessing the production quality test of the HETS.

verify corrective actions for failure types that occurred in the prior test after 8,000 miles; and (3) demonstrate the durability of major HETS components, such as the tractor's engine that in its fielding configuration had yet to be subjected to any endurance operation in a realistic environment.

Our review indicates that the Army has not adequately justified a reduced production quality test that, in effect, relieves the contractors of the cost to correct any system failure types that might occur after 8,000 miles. The urgency to field the system a year earlier has not been manifested in the Army's past actions. The Army identified the need for a new HETS in the early 1980s, but did not start contracting until 1989.

Mission Effectiveness and Suitability Not Demonstrated in Operational Test

The HETS has not adequately demonstrated the capability to accomplish its mission or its suitability for fielding because the mission profile actually run in the operational test was less rigorous than required.

Army officials told us that the mission profile that they planned to use in the operational test was based on a weighted average of all HETS mission profiles. They added that the weather often made the secondary roads, trails, and cross-country course impassable to all vehicles, including the HETS. Consequently, many of the miles planned for the more rigorous surfaces were actually driven on primary roads.

Also, the HETS most difficult mission may not have been demonstrated in the test.⁶ The HETS' required operational capability document requires that the HETS be capable of limited operations on unimproved roads, trails, and cross-country at the tactical support mobility level. The tactical support mobility level—one of a series of standard wheeled vehicle terrain profiles—requires that a system operate 30 percent on primary roads, 55 percent on secondary roads, 10 percent on trails, and 5 percent cross-country. Army officials told us that the tactical support mobility level was the same as the profile for the HETS mission to evacuate tanks and other equipment and that this mission accounted for 20 percent of all HETS missions. However, the operational test planned mission profile apparently did not include a demonstration of the mobility required to perform this mission because it did not contain any miles driven on trails. A weighted average of all the HETS mission profiles should have included at least 2 percent on trails to demonstrate the recovery mission.

⁶Although the Army made some test results available during our review, it had not completed its analysis of the operational test results.

Table 1 shows the percentage of miles the HETS would be required to drive at the tactical support mobility level compared to the percentage of miles planned and actually driven in the operational test.

Table 1: Comparison of the Miles Planned to Actually Driven in the Operational Test

| Driving surface | Tactical support mobility profile | Operational test | |
|-----------------|-----------------------------------|-------------------------|-----------------|
| | | Planned mission profile | Actually driven |
| Primary roads | 30 | 52 | 74 |
| Secondary roads | 55 | 44 | 23 |
| Trails | 10 | 0 | 0 |
| Cross-country | 5 | 4 | 3 |

Source: GAO's analysis of Army data.

The HETS' suitability for fielding was not demonstrated during the operational test. A key to determining the system's suitability is a demonstration of adequate reliability and maintainability. However, the Army official responsible for assessing the operational test results told us that he has deferred the assessment of the HETS' reliability and maintainability until the production quality test is completed. He plans to use the production quality test results in his assessment of the HETS operational test reliability and maintainability. Using the production quality test results in this way is at odds with one of the basic purposes of an operational test—gauging the system's suitability for fielding when maintained by typical operators, crews, and units—because contractor personnel, not typical Army maintainers, are performing the HETS' maintenance during the production quality test.

Semitrailer Off-Tracking Poses a Significant Safety Problem

As of March 31, 1993, the HETS was involved in 14 safety incidents during testing attributable, in part, to the semitrailer's tendency to veer into the other lane. Army officials said that 12 of the 14 safety incidents were minor paint scrapes. This tendency, called off-tracking, occurs on curves and turns when the rear of the semitrailer swings out in the opposite direction from the turn. Test results show that the extent of the swing-out is 5.9 feet to the right and 5.4 feet to the left. According to the Army, the swing-out occurs because the semitrailer is equipped with steerable axles, which are necessary to meet maneuverability and bridge-crossing requirements. A characteristic of trailers with steerable axles is that the rear of the trailer

tends to track toward the outside of the turning arc. Conversely, nonsteerable axle trailers track toward the inside of the turning arc.

The Army required that the new HETS operate on U.S. public primary and secondary roads during peacetime. However, the U.S. Federal Motor Carrier Safety Regulations do not contain provisions concerning steerable axle trailers off-tracking on turns and curves. Because there were no U.S. regulations, the Army's contract specifications incorporated European standards, which require that the swing-out of steerable axle trailers the size of the HETS semitrailer not exceed 4.5 feet.

Primarily based on its analysis of the semitrailer off-tracking incidents, the system's safety review board has placed the new HETS in a high-risk safety severity category, which anticipates that death or system loss is unlikely but could possibly occur during the life of the system. The HETS off-tracking safety incidents that resulted in this classification included both one and two vehicle accidents. In one accident, a HETS overturned down an embankment. The driver reported that the accident occurred when he steered sharply left and applied the brakes after he felt the tractor pulling to the right. The abrupt left steering by the driver caused sufficient semitrailer off-tracking to drop the three most rear right axles of the semitrailer off the right side of the road, overturning the whole HETS down an embankment. In another accident, the HETS was completing a 45° right hand turn when the semitrailer swung into the other lane and its left rear side struck an oncoming automobile in the driver's left side. The automobile driver said she was unable to react quickly enough to avoid the accident because the semitrailer unexpectedly came into her lane as the two vehicles passed.

The contractor is currently working to develop hardware modifications to reduce off-tracking by 1.5 feet and make the semitrailer comply with the European standard. The system's safety review board believes such a reduction in off-tracking will not be sufficient to lower the high-risk safety severity category. However, in March 1993, the board proposed conditions, in addition to the proposed hardware modifications, that would lower the HETS safety classification to a medium risk severity category, which anticipates that severe personal injury or major system damage is unlikely but could possibly occur during the life of the system. These conditions included that all new HETS have (1) a driver who has received specialized training, (2) a second crew member to observe the road and traffic conditions while underway, (3) "wide load" signs posted front and rear, and (4) front and rear escort vehicles accompanying them. As of

June 1993, this issue remains open pending receipt of a proposal from the contractor on how to reduce the off-tracking.

Federal Highway Administration and National Highway Traffic Safety Administration officials told us that because of the new HETS' width and weight, the Army will have to obtain a state permit whenever it wants to operate the system on a public road. They said that all states will require at least wide-load signs and front and rear escort vehicles when vehicles the size and weight of the HETS are operated on public roads.

Army officials told us that when the HETS operates on a military installation's roads, the HETS' operating conditions are at the discretion of the installation's safety officer. A safety officer is not required to follow the system's safety review board's recommendations.

Army Pays Contractors Before System Meets Contract Requirements

Major systems must comply with the fly-before-buy policy, according to 10 U.S.C. 2399 and 2400.⁷ Although the new HETS' acquisition cost fell below the major system cost thresholds, the original HETS tractor and semitrailer contracts did minimize major funding commitments by requiring that the tractor and semitrailer meet contract requirements before the Army accepted delivery of production HETS. However, the Army authorized the start of production when it agreed to conditionally accept deliveries of HETS tractors and semitrailers before all contractual requirements were satisfied.

During Operation Desert Shield/Storm, the Army had an emergency need for HETS to move Abrams tanks. On December 19, 1990, the Army authorized the semitrailer contractor to start production and agreed to conditionally accept the semitrailers. Operation Desert Storm ended before any semitrailers were delivered. However, according to the Army, to avoid the substantial costs of shutting down production and the loss of the work force, it allowed the contractor, in May 1991, to continue to produce semitrailers. At the time, the Army expected to conditionally accept 75 semitrailers before first article approval—approval of the system's production configuration.

On August 12, 1992, the Army authorized the HETS tractor contractor to start production and agreed to conditionally accept the tractors in return for the contractor waiving any claims for additional costs associated with

⁷A system is considered a major system if total expenditures for research, development, test, and evaluation are estimated to be more than \$115 million, or if total expenditures for procurement are estimated to be more than \$540 million (based on fiscal year 1990 constant dollars).

testing delays caused by the government. The contractor's potential claims arose from the contractor awarding subcontracts in anticipation of a contractually established production start date. However, testing was delayed beyond that date and, according to Army officials, much of the testing delay was attributable to the government.⁸ At the time, the Army expected to conditionally accept 175 tractors before first article approval.

Under the conditional-acceptance agreements, both contractors agreed to retrofit the conditionally accepted tractors and semitrailers to the first article approval configuration to correct any deficiencies identified after they were produced. The semitrailer contractor agreed to pay all retrofit costs, while the Army has agreed to pay tractor retrofit costs in an amount equal to the contractor's extra expense caused by the government-caused testing delay, up to \$700,000. Until retrofitted, the contractors were to store the tractors and semitrailers at their own expense.

On April 28, 1993, the Army and the contractors agreed to modify both contracts to allow the extended production quality test. Based on current delivery schedules, the Army agreed to increase, as of April 1993, the number of tractors it would conditionally accept from 20 per month to 40 per month and, in July 1993, to 60 per month. It agreed to conditionally accept 15 semitrailers per month through the end of the year. Also, the Army increased the number of units it would conditionally accept to 535 tractors and 290 semitrailers. Based on current delivery schedules, the Army expects to have conditionally accepted 300 tractors and 193 semitrailers by the end of July 1993.

Testing delays forced the Army to postpone the milestones for completing production quality testing, first article approval, and fielding. For example, the Army planned to conduct the production quality test over an 8-month period. However, the test is now scheduled to run 25 months—17 months more than planned. As a result of testing delays, the Army has rescheduled the HETS' first article approval to March 1994, with fielding following in April 1994. The cumulative effect of these delays on the first article approval is shown in table 2.

⁸At the time of this decision, the testing had been delayed 11 months. The government caused 8 months of the delay—3 months because it did not have the personnel needed to conduct the test or prepare the testing course on time and 5 months because the semitrailers were not available for testing. The semitrailer is considered government-furnished equipment for the tractor test.

Table 2: Original and Current Milestones for First Article Approval

| Item | First article approval milestone | | |
|-------------|----------------------------------|------------|------------------------|
| | Original | Current | Extent of postponement |
| Tractor | March 1992 | March 1994 | 2 years |
| Semitrailer | July 1990 | March 1994 | 3 years and 8 months |

The postponement of the first article acceptance milestone has caused the Army to conditionally accept more tractors and semitrailers than it previously intended. As shown in table 3, based on the current delivery schedules, by the current first article approval milestone date of March 1994, the Army will have paid \$215.5 million for 935 tractors and 320 semitrailers before the new HETS has demonstrated that it has met contractual reliability and maintainability requirements.

Table 3: Projected Payments to Contractors for Conditional Acceptance Deliveries as of March 1994

| Dollars in thousands | | | | |
|----------------------|---------------------------------|------------------|-----------------------------|---------------------------|
| Contractor | Conditional acceptance quantity | Total payments | Contract total ^a | Percent of total contract |
| Tractor | 935 | \$182,439 | \$234,146 | 77.9 |
| Semitrailer | 320 | 33,034 | 127,748 | 25.9 |
| Total | | \$215,473 | \$361,894 | 59.5 |

^aContract totals are as of April 1993.

Source: GAO's analysis of Army data.

Because of the Army's significant investment in the conditional acceptance of tractors and semitrailers, completely testing the new HETS is critical to identify any deficiencies, so that the contractors rather than the government are liable for the costs to correct those deficiencies.

Recommendations

Because of our reservations regarding the limited testing and the Army's need to know whether the HETS can meet its intended mission, we recommend that the Secretary of Defense require the Army to perform (1) a new production quality test at the contractually required mileage and (2) a new operational test of the new HETS using the current HETS mission profile.

To minimize the Army's funding commitment before the Army is sure the new HETS can accomplish its intended mission, we also recommend that the Secretary of Defense direct the Army to stop conditionally accepting HETS tractors and semitrailers once the currently authorized limit is met—535 tractors and 290 semitrailers—until the HETS shows that it can meet its intended mission and reliability and maintainability requirements.

In view of the highway safety issue, we further recommend that the Secretary of the Army require compliance with the system's safety review board's conditions regardless of whether the new HETS is operated on public roads or roads located on military installations.

Scope and Methodology

We interviewed and obtained program documents from officials in the Department of the Army headquarters, Washington, D.C.; the Program Executive Office, Combat Support, U.S. Army Tank-Automotive Command, Warren, Michigan; U.S. Army Transportation School, Fort Eustis, Virginia; U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland; U.S. Army Operational Evaluation Command, Alexandria, Virginia; and the Military Traffic Management Command Transportation Engineering Agency, Newport News, Virginia. We interviewed officials of Southwest Mobile Systems Corporation, St. Louis, Missouri. Also, we discussed the operation of the HETS on public roads with officials of the Federal Highway Administration and the National Highway Traffic Safety Administration, Department of Transportation, Washington, D.C. We conducted our review from September 1992 to July 1993 in accordance with generally accepted government auditing standards.

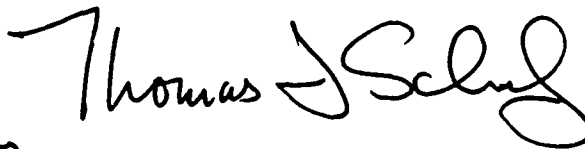
As requested, we did not obtain official comments from DOD on this report. However, we discussed the issues in this report with officials from the Office of the Secretary of Defense and the Department of the Army and have incorporated their comments where appropriate.

Unless you announce its contents earlier, we plan no further distribution of this report until 30 days after its issue date. At that time, we will send copies to the Chairmen and Ranking Minority Members of the Senate and House Committees on Armed Services and on Appropriations and the House Committee on Government Operations; the Chairman of the Senate Committee on Governmental Affairs; the Director, Office of Management

and Budget; and the Secretaries of Defense and the Army. We will also provide copies to others upon request.

Please contact me on (202) 512-4841 if you or your staff have any questions concerning this report. Other major contributors to this report are listed in appendix I.

Sincerely yours,

for 
Louis J. Rodrigues
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